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ABSTRACT

This document presents a training course on the marine ecology of the Red Sea designed by the Arab League Educaticnal, Cultural and Scientific Organization (ALECSO) in collaboration with the Marine Science Department cf UNESCO for the Program for Environmental Studies, Red Sea and Gulf of Aden (PERSGA). It was hosted by the Marine Science Station, Ghardaqa, Egypt from March 5th to April 9th in 1977. Two groups participated in teaching the course: (1) a group of German marine scientists recruited by UNESCO; and (2) a group of Egyptian marine scientists from the University of Alexandria and from the Institute of Oceanography and Fisheries (IOF), Egypt. The course content, name of instructors, and distribution of hours are also presented. (HM)

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THE ARAB EDUCATIONAL CULTURAL
AND SCIENTIFIC ORGANIZATION

109, Tahrir Str.- Dokki-Cairo
A. R. Egypt

Red Sea & Gulf of Aden Programme
PERSGA

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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TRAINING COURSE ON THE MARINE ECOLOGY OF THE RED SEA

SE 024 785

TRAINING COURSE ON THE MARINE ECOLOGY OF THE RED SEA .

This course was especially designed for PERSGA in collaboration with the Marine Science Dep. of the UNESCO. It was hosted by the Marine Science Station, Ghardaqa, EGYPT; 5 March - 9 April 1977.

The plan of teaching divided the tasks among two groups, viz,

1. Group of German marine Scientists led by Prof. Dr. Hans Mergner, recruited by UNESCO, and
2. Group of Egyptian marine scientists from the University of Alexandria, and from the Institutes of Oceanography and Fisheries (IOF), Egypt,

1. Prof. Dr. Hans MERGNER and his Staff:

A. LESSONS and SEMINARIES with DISCUSSIONS (69 hrs.+ 2 add. hrs.)

1. GENERAL PART (57 hrs. + 2 additional hrs.)

1. Introduction into the problems (MERGNER: 1 hr.)

a. Comments to the programme
b. Geographic remarks on the Red Sea region and its paleographic formation
c. History of the scientific exploration of the Red Sea.

2. Distribution, types, morphology and development of reefs Mergner: 8 hrs.)

a. Definition of the reef: Stromatolit-reefs, stony coral-reefs, algal-reefs, vermetid-reefs, serpulid-reefs, sabellarid-reefs, zoanthid-reefs, stromatoporid-reefs (1 hr.).
b. The conditions for formation and distribution of reefs. The Indopacific and Caribbean reef provinces (1 hr.)
c. The reef types and the theories of their origin (1 hr.).

d. Reef types and their distribution in the Red Sea area (1 hr.)
e. Reef topography and its structural zones, including the shore zone (1 hr.)
f. Influences of the abiotic and biotic parameters on origin, growth and destruction of the reefs (1 hr.)
g. The developmental cycle and the geological fate of the reef. Special aspects of the Red Sea reefs (2 hrs.).

3. System, biology and ecology of corals (MERGNER: (7 hrs.)
   a. The systematic categories of hydrocorals, stony corals, soft corals, gorgonarians, zoantharians and antipatharians, including morphology and anatomy (2 hrs.)
   b. Generative and vegetative propagation of corals (1 hr.)
   c. Short outline of the nutrition of corals and the importance of the zooxanthellae (1 hr.)
   d. Short outline of the calcification, skeleton and colony formation of corals (1 hr.)
   e. Ecological pretensions of the reef corals: temperature, salinity, sedimentation with quantitative and qualitative distribution of light and shadow, water exchange and water movements, substrate (2 hrs.)

4. Reef building and reef destructing organisme (MERGNER: 5 hrs.)
   a. Reef building organisms: calcareous algae, foraminiferae, hydrocorals, stony corals, bryozoa, molluscs (1 hr.)
   b. "Binding" of the organogenic reef skeletion by the processes of sedimentation, binding, cementation et. al., dynamics of the reef growth and destruction (2 hrs.)

c. Reef destructing organisms like predators: molluscs, echinoderms and fishes; like boring organisms, blue and green algae, sponges, tube-worms, bivalves, sipunculids and echinoderms; space concurrence (2 hrs.)

5. Reef ecology, including the shore zone (MERGNER: (8 hrs.)

a. The reasons for the enormous species diversity of reef animals: the ecological niches and other factors (1 hr.)
b. Fauna and flora, including reef plankton organisms. as inhabitants of reef areas, shore zone and mangrove, with special interest on Red Sea coral reefs (2 hrs.)
c. Dominant species, sociological and biophysiogr-aphical zonation of the different reef landscapes (1 hr.)
d. Indicator species and their use for ecological investigations of coral reefs with special reference to the hydroidpolyp growth of Red Sea reefs (1 hr.)
e. Characteristic biocenoses of the reef zones, their sessile and mobile animals and their coral communities, also their autecological and synecol-ogical interactions within the different reef zones (2 hrs.)
f. The differences between day-light and night-aspect (1 hr.)

6. Energy flow and productivity in the reef (SVOBODA: 12 hrs.)

a. The ODUM-model as aim for understanding: the energy flow diagram of the reef (1 hr.)
b. Primary productivity (producers): photosynthesis as the chemical mechanism, light conditions in the reef adaptions in photosynthetic pigments, primary productivity in pelagic and benthic algae, in eelgras and corals containing symbiotic

zooxanthellae (2 hrs.)

c. Secondary productivity (consumers): grazing on benthic algae and eelgras, grazing on corals; filter feeders with various strategies in the uptake of macro- and microplankton, bacterial, microparticles, detritus and slime particles; uptake of dissolved organic matter; nutrition by symbiotic algae in various hosts (2 hrs.)

d. Decomposers and their effect on the nutrient cycle (1 hr.)

e. Skeleton formation in organisms (calcification): herma-typic corals, octocorals, calcareous algae, foramini ferae et. al. (1 hr.)

f. Methods of energy flow studies: O_2-production and or respiration of individuals or communities in bell jars (WINKLER technique and recording methods, short and long term studies), O_2-changes in the free water column, quantitative plankton sampling across the reef, labelling techniques: ^{14}C for primary productivity and turnover rates, ^{3}H and ^{14}C labelling in uptake experiments of dissolved organic compounds, like carbohydrates and aminoacids (3 hrs.)

g. Growth rate studies in stony corals and other benthic organisms: ^{45}Ca labelling technique in calcification rate studies, weight increase measurements, new optical methods in biomass determination as stereophoto grammetrical method (2 hrs.)

7 Ecological behaviour of reef animals and life communities

(MAGNUS: 12 hrs.)

Lectures on ecological and ethological observations and experiments on some important life forms in the littoral:

a. Supralittoral and upper eulittoral:

a-1. On the land hermit crab Coenobita scaevola Forskol/Crustacea, Decapoda(1 hr.)

a-2 On the ghost crab Ocypode saratan Forskål and the fiddler crab Dotilla sulcata/Crustacea, Decapoda (1 hr.)

a-3 On the amphibious fishes Lophalticus Kirkii magnusi Klausewitz and Istiblennius rivulatus (Ruppel)/Pisces, Salaridae (1 hr.)

a-4 On the amphibious mudskipper Periophthalmus kalolo Lesson/Pisces, Gobiidiformes, and the fiddler crabs of the genus Uca/Crustacea, Decapoda (1 hr.)

a-5 On the resting clusters of the shore snail Planaxis sulcatus (Born)/Mollusca, Prosobranchia (1 hr.)

b. Eulittoral:

a-6 On the brittle star Ophiocoma scolopendrina (Lamarck)/Echinodermata, Ophiuroidea (1 hr.)

c. Sublittoral:

a-7 On the feather star Heterometra savigny (J.Muller)/Echinodermata, Crinoidea, the sea feather Scytaliopsis dijboutiensis Grav./ Octocorallia, Pennatularia, and the basket star Astroboa nuda Lyman/Echinodermata, Ophiuroidea, Gorgonocephalidae (1 hr.)

a-8 On the symbiosis between Alpheus shrimps/ Crustacea, Decapoda, Natantia, and gobiid fishes, and on the partnership between Diadema sea urchins/Echinodermata, Echinoidea, and other animals (1 hr.)

a-9 On special relationships between fishes and environment: garden eels Gorgasia sillneri Klausewitz, cleaning fishes Labroides dimidiatus and Aspidontus, anemone fishes Amphiprion, and Plotosus anguillaris (Bloch) (1 hr.)

a-10. On social correlations between fishes: Amphiprion becinctus (Ruppell), Dascyllus trimaculatus (Ruppell), Chaetodon (1 hr.)

Short film strips in or between the lectures and additional films in evening fem shows (2 additional hrs.)

a. Coenobita scaevola (1 film)
b. Ocypode saratan (2 films)
c. Dotilla sulcata (3 films)
d. Lophalticus kirkii (1 film)
e. Periophthalmus kakolo (1 film)
f. Uca (2 films)
g. Ophiocoma scolopendrina (3 films)
h. Scytaliopsis dijboutiensis (2 films)
i. Alpheus symbiosis with gobiid fishes (2 films)
k. Diadema setosum (1 film)
l. Gorgasia sillneri (1 film)
m. Labroides dimidiatus (2 films)
n. Aspidontus imitating Labroides (2 films)
o. Chaetodon couple-forming (1 film)
p. Dascyllus trimaculatus (1 film)
q. Odonus niger (1 film)
r. Rhinecanthus assisi (1 film)
s. Fish movements (10 films)

8. Applied coral reef ecology (MERGNER, SVOBODA: 2 hrs.)

a. Usufruct of reef lagoons for marine farming (1/2 hr.)
b. Pollution of coral reefs by oil, phosphate-eutrophication, focalisation, thermal-factors and other human influences(1 hr.)
c. Tourism, fisheries and reef protection(1/2 hr.)

9. Film show: "The Coral Gardens of Shadwan" (MERGNER: 2 hrs.)

comments to a 48 minutes - sound film from the Ghardaqa-region, as a summary of the general part of the lessons on the coral reef ecology.

II. SPECIAL PART (12 hrs.)

1. Discussions of ecological investigations on coral reefs (MERGNER: 9 hrs.)

a. Structure, ecology and zonation of Red Sea reefs: Reef morphology and biophysiographic zonation of reef examples of the Port Sudan area, the Jeddah area and the Sinai coast (2 hrs.)

b. The physiographic zonation and the ecological conditions of some South Indian and Ceylon coral reefs: The meteorological, geological and local ecological influences cause different reef types near Mandapam Camp and Hikkaduwa (2 hrs.)

c. Morphology, ecology and zonation of coral reefs near Aqaba (Gulf of Aqaba, Red Sea): Detailed analysis of a coastal fringing reef and a lagoon fringing reef (1 hr.)

d. Productivity and seasonal changes in selected reef areas in the Gulf of Aqaba: An ecofunctional analysis of the changing structures of the life communities and of the seasonal increase of the productivity (2 hrs.)

e. The influences of several ecological factors on the hydroid growth of some Jamaican coral cays: A special analysis of the influences of water movement, light intensity and substrate on the settlement, growth intensity and outspread of hydropolyps in coral reefs (1 hr.)

f. Hydroids as indicator species for ecological parameters in Caribbean and Red Sea coral reefs: The usufruct of hydropolyps for zonation and determination of the influences of abiotic factors in coral reefs (1 hr.)

2. Discussion of sociological and ecological methods for the scientific field work on coral reefs (MERGNER: 3 hrs.)

a. The Heron-Island Protocols and the nomenclature of reefs (1 hr.)

b. The sociological method according Scheer and Mergner (1 hr.)

c. The transect-method according Loya and the test area-method according Mergner (1 hr.)

B. COURSES, EXCURSIONS and FIELD TRAINING (36 hrs.+ 60 add. hrs.)

1. FAUNA and FLORA of the GHARDAQA REEFS (10 hrs.+60 add.hrs.)

1. Study of algae and animals of the eulittoral, of the reef lagoon and the reef platform (MERGNER with MAGNUS and SVOBODA: 5 hrs. + 5 additional hrs.)

a. Observations, demonstrations and samples from the natural habitats of the above mentioned reef zones (3 hrs.+ 3 additional hrs.)

b. Demonstration of Red Sea benthos and fishes by the mean of color slides (2 hrs.)

c. Study of Red Sea fishes and invertebrates in the Ghardaqa museum (2 additional hrs.)

2. Study of benthic animals of the reef slope and fore reef sampled by scuba divers (MERGNER with SVOBODA: 2hrs + 2 additional hrs.)

Macroscopical and microscopical demonstrations and preparations in the laboratory.

3. Study of life communities and biophysiographic zones of the upper reef regions from the eulittoral to the reef edge (MERGNER with MAGNUS and SVOBODA: 3 hrs.+ 3 additional hrs.)

a. Day-light aspect (3 hrs.)

b. Night aspect (3 additional hrs.)

4. Ethological observations and demonstrations nearby the Marine Station (MAGNUS with MERGNER and SVOBODA: 10 additional hrs.)

Coenobita, Ocypode, Dotilla, Istiblennius, Planaxis, Ophiocoma, Heterometra, Scytaliopsis, Alpheus symbiosis with gobiids, Diadema partnerships, Labroides, Amphiprion

5. Ethological experiments to be done by the trainees in the field nearby the Station and in the laboratory (MAGNUS with MERGNER and SVOBODA: (10 additional hrs.)

a. Coenobita: change of the shell (1 hr.)

b. Planaxis: marking of the clusters with different colours (2 hrs.)

c. Ophiocoma: releasing of the different forms of feeding by attractive food and releasing of the aggressive territorial behaviour (2 hrs.)

d. Diadema: releasing of the partnerships with fishes by dummies (2 hrs.)

e. Alpheus shrimps: measuring of the daily dislocation of the hole (1 hr.)

f. Scytaliopsis: releasing of the slow respectively quick retraction reaction (2 hrs.)

II. EXCURSIONS (10 hrs.+ 10 additional hrs.)

1. Whole day bus-excursion to Kosseir (MERGNER with MAGNUS and SVOBODA: 6 hrs.+4 additional hrs.)

a. Demonstration of the original place of the world-wide first reef zonation from 1872 by Dr. Klunzinger (2 hrs.)

b. Demonstration of the reef pollution by phosphate-mining and of the adaptions of reef animals to it (2 hrs.)

c. Ethological observations and demonstrations in the reefs nearby Kosseir (2hrs.) Lophalticus, Uca, Coenobita.

2. Half day boat-excursions to Gaftun Seghir and other offshore islands (MERGNER with MAGNUS and SVOBODA: 4 hrs.+ 6 additional hrs.)

a. Demonstration of the reefs and their life communities at Gaftun Seghir (2 hrs.)

b. Ethological observations and demonstrations in the reefs of Gaftun Seghir: Lophalticus, Coenobita (2 hrs.)

c. Free excursion to another off-shore island (4 additional hrs.)

III. SCIENTIFIC ECOLOGICAL FIELD TRAINING (16 hrs.+ 20 add. hrs.)

1. Investigation of reef structures, biophysiographi-zones, fauna and flora, and life communities along two transects from the shore to the reef edge (MERGNER with MAGNUS and SVOBODA: 8 hrs.+ 8 add.hrs.)

a. Field work: measuring of abiotic parameters, drawing of the transect-line, enumberating of the species and specimens of all animals along the transect-line (4 hrs.)

b. Evaluating of the results by the means of statistical and graphical methods (4 additional hrs.)

2. Analysis of selected test areas of the reef lagoon and the reef platform (MERGNER and SVOBODA with MAGNUS: 8 hrs. + 12 additional hrs.)

a. Field work: measuring of the abiotic factors, drawing of the structural aspect of the test square with their biophysiographic zones, identifying of the species, enumberating of the specimens, ascertaining of the life communities, observing of the biotic interactions between their members (MERGNER with SVOBODA and MAGNUS: 4 hrs. + 4 additional hrs.)

b. Analysis of the respiration/productivity ratio of single members of these life communities, of their oxygenpretensions and of their increase of biomass (SVOBODA with MERGNER and MAGNUS: 4 hrs.+ 4 add. hrs.)

c. Evaluating of the results by the means of statistical and graphical methods (SVOBODA: 4 additional hrs.)

Remarks: The regular hours belong to the normal stock of 6 hours daily which are provided for the official time-table of the training course.

The additional hours give the possibility of additional information, of self-studies and finishing field work or experiments. The given number of these additional hours should not be exeeded.

Each teacher is responsible for the subdivision of the time allocated to him between lectures, practical and field work.

2. Egyptian Staff.

1) OCEANOGRAPHIC FEATURES OF THE RED SEA
(33 hrs)

A- Physical Oceanography: (Dr. Makram A. Gerges-10.)

1. Pysiography of the Red Sea:"1 hr. "
Geographical location, Dimensions,
Bathymetry, Climatical Conditions.

2. General Description of Hydrographic Conditions in the Red Sea: " 2 hrs "

a) Temperature; vertical and horizontal distributions.

b) Salinity; vertical and horizontal distributions.

c) Oxygen.

3. Water Masses of the Red Sea.." 1 hr. "
Distribution of the different water masses-
Phenomenon of deep-water formation.

4. Water circulation in the Red Sea: " 2 hrs. "
Currents - Thermohaline circulation - Winter and summer circulation patterns.

5. Water Exchange: ..... " 2 hrs."

a) with the Indian Ocean through the Gulf of Aden.
b) with the Mediterranean Sea through the Suez canal.

6. Tides - Tidal Currents - Mean Sea Level " 2 hrs."

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B- Chemical Oceanography: (Dr. Mamdouh Abbas - 12 hrs.)

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he Chemistry of Sea Water:

1. Water and Sea Water.

2. The constancy of compoition of **Sea Water.**
3. The variability of composition of Sea Water.
4. The determination of salinity.
5. Major ions.
6. Dissolved gases.
7. Nutrient salts.
8. Minor crgaric disselved compounds .
9. Buffer capacity of sea Water.
10. Special characteristics of the chemistry of the Red Sea.

C- Metorological Conditions of the Red Sea:

..... (Dr. M.M. Osman - 7 hrs.)

Introduction and basic principles.

Part 1: Meteorological conditions of the sea:

1) Physiographic features.
2) General effects of topography on the mean atmospheric circulation in the lower troposhere.
3) Pressure centres and wind flow patterns.
4) General character of the weather.

Part 2: Interaction between the sea and the atmosphere.

1) Heat balance of the Red Sea.
2) Water balance of the Red Sea.
3) Sea level variations.
4) Water circulation in the Red Sea.

D- Geological history: (Dr. Mohamed A. El-Sabarouti - 7 hrs.)

1. Introduction.
2. Geologic development of the Red Sea.
3. Sedimentary History of the Red Sea.
4. General stratigraphy of the adjacent land areas of the Red Sea.

II. Marine Communities of the Red Sea

Plankton and Food Cycle (Dr. Sami A. Sheaban - 8 hrs.)

1. General accounts.
2. Adaptation of the planktonic life.
3. Study of zooplankton and phytoplankton.

4. Environmental factors.
5. Practical.

Bottom Fauna ..... (Dr. A. Ghobashi - 5 hrs.)

1. Definitions for the bottom fauna communities.
2. Their global distribution.
3. Fouling organisms as bottom fauna.
4. Effect of substratum and other environmental factors on the settlement of the larvae of the bottom fauna.
5. Methods of bottom fauna collection.
6. Their significance as mombers in the biota.

Algal Flora ..... (Dr. A. Ibrahim - 8 hrs.)

Introduction.

chemical Composition of algae in relation to the:

1. Light
2. Tempersature.
3. Chemical nutrients
4. Depth
5. Location.

Indentification of algae.
Ecomomical value of algae.

Primary Production .....(Dr. A. Ibrahim - 8 hrs.)

Introduction.

Controlling Factors.

a) Compesition of phytoplankton.
b) Chemical composition of phytoplankton in relation of the nutrient salts in sea water:
d) Effect of:

I) Light II) Temperature III) Chemical nutrient.

Cultures of marine phytoplankton and measurement of photosynthesis.

. Culture vessels.
. Isolating single cells.
. Culture redia for marine phytoplankton.
. Messurement of oxygen production.
. The $^{C}14$ method for determenining the intensity of photosynthesis.
. Pigment extraction.
. Computation of the number of individuals by counting.

IV FISHERIES OF THE RED SEA (40 hrs.)

A- Methods of Fishing (Dr. A. H. Shaheen - 5 hrs.)

Five lectures in Fishing Methods.

The fishing methods are referred to all those implements and devices that are used for catching fish.

The items discussed to cover the most important elements of the subject are:

Historical introduction.

Fishing gear technology.

Principles of fishing methods.

Explanation of the main methods including:

1. Trawl nets	2. Surrounding nets
3. Lift nets	4. Gill nets.
5. Traps.	6. Pound nets.
7. Cast nets	8. Hooks and lines.

B- Commercial catch and types of fish landed as obtained from statistical data (Dr. Khamis A. Hussein 10 hrs.)

- Some physical and biological characters of the Red area.
- Factors limiting abundance of fishes in the Red Sea.
- Commercial fishes in the Red Sea.
- Relation of life history to fishery management.
- Types of fishing gear used in the Red Sea.
- Factors affecting estimation of fish population.
- Methods of estimating population Size.
- Age determination and age composition.
- Relation between mesh size of fishing gear and fish size.
- Fishery management.

C- Outline of fish taxonomy, abundant Fish species and biological charateristics of Fishes:

(Prof. A. R. Bayoumi - 15 hrs.)

Introduction:

Part 1: Outline of Fish Taxonomy " 2 hrs."

- Scientific nomenclature.

. Classification of fishes.
. The use of classification keys for Identification of fish Genera & Species.

Part 2 : Abundant Fish Species of the Red Sea.

3 hrs. Lecteres 3 hrs.

. A check list of fishes of the Red Sea.
. Examples of the important fishes.
. Seminar on: ..... " 1 hr. "
  a) Venomous and poisonous fishes of the Red Sea.
  b) Sound - production & sound producing mechanisms in fish.

Part 3 : Biological Characteristics of Fishes.

4 hrs Lectures 2 hrs

Practical:

. Main morphological & anatomical characters of fish.

  Body form and its modification. " 1 hrs "

. Food and feeding habits of fishes 1 hr.
. Sensory organs of fishes ..... 1 hr.
. Reproduction..... 1 hr.